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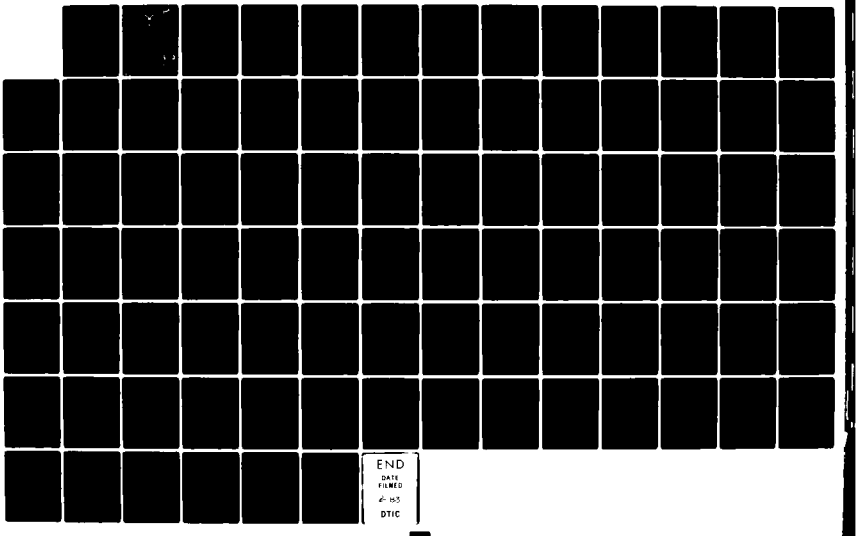

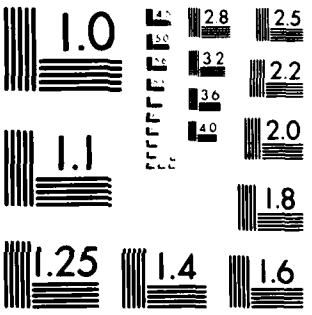

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COMBINATIONS OF INDIVIDUAL AND ORGANIZATIONAL VARIABLES AND THEIR RELATIONSHIP TO STRESS AND CORONARY HEART DISEASE RISK FACTORS

Steven T. Lofgren, Captain, USAF

LSSR 5-82

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The research examined the joint effect of organizational stressors and individual traits on stress responses and coronary heart disease risk factors. A questionnaire measured role conflict, organizational climate, locus of control, and Type A/B behavior patterns. Blood analysis determined the levels of cortisol, total cholesterol, and HDL cholesterol. Factor analysis associated questions with constructs. Multiple regression and analysis of variance were used to test relationships between organizational/individual factors and perceived job stress/coronary heart disease risk factors. The interaction of role conflict and Type A/B behavior pattern was negatively related to cortisol level. Analysis of variance failed to further explain this relationship. No other significant interaction terms were found. Relationships between main effects and dependent variables are shown in Table 1.

LSSR 5-82

COMBINATIONS OF INDIVIDUAL AND ORGANIZATIONAL VARIABLES AND THEIR RELATIONSHIP TO STRESS AND CORONARY HEART DISEASE RISK FACTORS

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirement for the

Degree of Master of Science in Engineering Management

By

Steven T. Lofgren, BS
Captain, USAF

September 1982

This thesis, written by

Captain Steven T. Lofgren

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN ENGINEERING MANAGEMENT

DATE: 29 September 1982

William K. Hendrix
COMMITTEE CHAIRMAN

Dedication

This thesis is dedicated to my wife, Jackie, who did all the typing and who patiently coped, or helped me to cope, with all problems which arose during the course of this research effort.

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I would like to thank the following people for the advice and support they gave me during the course of this research effort:

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CHAPTER I

INTRODUCTION

In 1979, cardiovascular disease was responsible for almost one million fatalities in the United States. This was well over one-half of all reported deaths. (5:ix) Since the early 1900's, the medical field has suspected that stress "can augment the development of cardiovascular disease, most especially . . . coronary artherio-sclerosis (5:1924)". Additionally, stress has a variety of organizational outcomes, including absenteeism, poor productivity, and job dissatisfaction (27:14). Clearly, there is a need to understand and eliminate the conditions which precede stress and, subsequently, coronary heart disease (CHD).

The medical field has based their investigation of the cause of CHD on CHD risk factors. These CHD risk factors include serum cholesterol levels, blood pressure, cigarette smoking, and others (29:48). The link between CHD and stress is through the CHD risk factors. Basically, stress causes physiological changes, such as high blood pressure, which in turn become CHD risk factors, and can lead to CHD.

One CHD risk factor which is affected by stress is total blood cholesterol. Stress causes levels of cholesterol in the blood to increase. This was shown in a study by Friedman, Rosenman, and Carroll (17:852). They investigated the effects of various stressors,

such as work load and time pressure, on total cholesterol levels. The subjects in the study were tax accountants. The researchers found that as the April 15 tax filing deadline drew near, the subjects' total cholesterol levels rose. After the deadline passed, it took two months for the cholesterol levels to return to normal.

Total blood cholesterol is composed of three separate lipoproteins: low density lipoprotein (LDL), very low density lipoprotein (VLDL), and high density lipoprotein (HDL). LDL represents approximately 70% of total cholesterol, VLDL represents 10%, and HDL represents 20%. (14:169) Medical studies have established the positive relationship between total cholesterol, LDL, and VLDL and the risk of CHD (14:169). Basically, this relationship works as follows. Almost all CHD is preceded by coronary artery disease. The primary artery disease is artheriosclerosis. This is the accumulation of cholesterol deposits on arterial walls which causes the artery to harden and narrow. This restricts the flow of blood through the artery and can lead to clotting. These blood clots are the major cause of heart attacks. (27:93)

Medical studies have also shown that HDL is a risk lowering factor (14:169). That is, the risk of developing CHD is lower if a person has high concentrations of HDL. This is because HDL inhibits the collection of LDL and VLDL on arterial walls, ensuring that the arteries accumulate less cholesterol (14:171).

The last CHD risk factor associated with cholesterol is the ratio of total cholesterol to HDL (14:171). This ratio is positively

related to the risk of CHD. Thus, as the total cholesterol/HDL ratio increases, the risk of CHD increases.

In addition to their studies concerning CHD risk factors, medical researchers have investigated other physiological indications of stress. One of these is the cortisol level. Cortisol is a steroid hormone released by the adrenal glands. Medical studies have shown that as stress increases, cortisol levels increase (6:956; 38:817).

Medical researchers have not been alone in studying stress. In recent years, more and more behavioral and managerial researchers have been studying the causes and effects of human stress. These researchers have generally investigated preceived stress rather than physiological indications of stress. The studies have shown that there are a variety of stressors, or antecendents of stress. These include: organizational stressors, such as role conflict; stressors in the home, such as marital relations; social stressors, such as social activities; and, individual traits, such as locus of control (12:566). Unfortunately, very few of the studies have included measurements of physiological indications of stress, such as total cholesterol level.

This study is part of a continuing effort to investigate the antecendents and consequences of stress. It draws upon an existing data base developed by members of a previous Air Force Institute of Technology (AFIT) research team. Their research effort identified the organizational stressors and individual traits which predict both preceived stress and CHD risk factors, such as total cholesterol,

HDL, and the total cholesterol/HDL ratio. Their study was a multidisciplinary (medical/managerial) attempt to relate stressors to stress and physiological outcomes (CHD risk factors). Thus, it bridged the gap between the medical researchers and the managerial researchers.

Most researchers agree that it is not just the job nor is it just the individual traits which lead to stress. Rather, it is a combination of both. Ivancevich and Matteson (34:353) propose that:

> Different individuals will react differently to the same set of organizational stressors. The impact of the differences in reaction will manifest themselves in measures of physiological and behavioral outcomes.

Thus, the next step in the research process is to examine the joint effect of organizational stressors and individual traits on stress responses and CHD risk factors. That step, the examination of the joint effect of organizational stressors and individual traits on stress responses and CHD risk factors, is the purpose of this study.

The organizational stressors used in this study were role conflict and organizational climate. The individual traits were Type A/B behavior patterns and locus of control. The following are brief definitions of these constructs. The literature review also defines these constructs and discusses their relationship to stress and CHD risk factors.

Role Conflict--"conflict that results when compliance with one set of role pressures makes compliance with another set difficult or impossible [27:238]."

Organizational Climate--the environment which results from "the interaction of the people, structure, policies, and goals of an organization [27:238]."

Type A/B Behavior Patterns—Type A behavior is characterized by competitiveness and a sense of time urgency. Type B behavior is the opposite of Type A, or more relaxed type of behavior.

Locus of Control—the degree to which a person feels he or she has control over their lives. Internals believe they control their lives, while externals believe forces outside themselves control their lives.

The research previously conducted with the date base used in this study discovered several organizational stressors and individual traits which were predictive of stress and CHD risk factors. However, the addition of 48 new cases necessitated verification of those results. The following hypotheses were developed for this purpose:

1. Role conflict is positively related to perceived job stress.
2. Organizational climate is negatively related to perceived job stress.
3. Organizational climate is negatively related to the total cholesterol/HDL cholesterol ratio.
4. Type A behavior is positively related to perceived job stress.
5. External locus of control is positively related to perceived job stress.

The next step in this study was to examine the joint effect of the organizational stressors and individual traits. The following research questions were developed to explore these joint effects:

1. What combinations of organizational stressor and individual trait are predictive of perceived job stress?
2. What combinations of organizational stressor and individual trait are predictive of cortisol level?

3. What combinations of organizational stressor and individual trait are predictive of total cholesterol level?

4. What combinations of organizational stressor and individual trait are predictive of HDL cholesterol level?

5. What combinations of organizational stressor and individual trait are predictive of the total cholesterol/ HDL cholesterol ratio?

CHAPTER II

LITERATURE REVIEW

The purpose of the literature review was to investigate the research to date which links the specific organizational and individual factors of interest to this study to stress and CHD risk factors. First, a background of stress research and stress models is presented. Next, the stress research investigating two organizational factors, role conflict and organizational climate, and two individual factors, locus of control and Type A/B behavior, is discussed. Finally, research concerning cortisol levels and the CHD risk factors is analyzed.

Background

Most recent models of occupational stress (12:564; 34:347; 4:665; 24:12; 9:11; 27:44) propose a relationship between various antecendents of stress (organizational factors, social factors, family factors) and perceived stress. Individual differences (age, sex, Type A/B behavior, and others) moderate this relationship. Furthermore, there is a proposed relationship between perceived stress and both organizational outcomes (job satisfaction, productivity) and CHD risk factors (blood pressure, cholesterol levels).

Almost all of these research models and literature reviews agree that there is a need for an interdisciplinary approach to the

study of stress (27:49; 4:696; 34:354; 12:564; 24:24; 9:25). In an effort to fill this need, two students at AFIT, Fye and Staton (19), conducted a thesis to identify the organizational and individual factors which were related to perceived stress, cortisol levels, and CHD risk factors (total cholesterol, HDL cholesterol, and the total cholesterol/HDL ratio). A 139 item questionnaire was developed which measured organizational factors, individual factors, perceived stress, and demographic data. Blood samples were taken from each subject to measure each person's cortisol and cholesterol levels. After eliminating subjects with incomplete data or who were on medication, there were 203 cases suitable for analyses. Factor analysis was conducted first, followed by multiple regression. The researchers found that perceived job stress was positively related to external locus of control, Type A behavior, and role conflict. Perceived job stress was negatively related to internal locus of control, Type B behavior, and organizational climate. Cortisol level was positively related to internal locus of control and organizational climate, and negatively related to external locus of control. Organizational climate was positively related to HDL level and negatively related tothe total cholesterol/HDL ratio. Organizational climate was one of the few factors found to be related to CHD risk factors. This may have been because the researchers did not control for either age or sex when using blood data as dependent variables.

Organizational Factors

Role Conflict

According to Ivancevich and Matteson (27:238), role conflict is "conflict that results when compliance with one set of role pressures makes compliance with another set difficult or impossible." The literature shows that role conflict is positively related to job stress (as role conflict increases, stress increases) (27:110; 44:48; 4:671; 12:571; 34:350; 9:12; 25:496). The following studies exemplify the research done in this area.

House and Rizzo (25:467) examined the relationship between role conflict and anxiety among 200 managers in a large, heavy equipment manufacturing firm. Role conflict and role ambiguity were measured using a 30 item questionnaire previously developed and validated by the authors. Anxiety was measured using a 26 item anxiety-stress questionniare, taking some items from the Taylor Manifest Anxiety Scale. The results indicate that role conflict was positively correlated with job induced anxiety ($p < 0.01$), somatic tension ($p < 0.05$), and general fatigue and uneasiness ($p < 0.01$).

Shirom, Eden, Silberwasser, and Kellermann (40:875) investigated the relationship between role conflict and CHD risk factors. They used a sample of 762 males who were over 30 years old living on a kibbutz in Israel. The sample was stratified into occupational groups. A significant relationship was found between role conflict and abnormal electrocardiograph readings in the white collar work group.

French and Caplan (15:38-39) summarize some of their role conflict research with the following conclusions: among managers, role conflict increases job-related tension ($r = 0.39$); mean heart rate is significantly related to self reported role conflict ($r = 0.61$); and, personality plays an important part in the subjects' reaction to role conflict.

Thus, there is considerable agreement that role conflict is positively related to perceived job stress. Additionally, there is weaker support for the positive relation between role conflict and physiological consequences, such as heart rate. However, very little research exists which examines the relationship between role conflict and cholesterol levels.

Organizational Climate

Organizational climate is defined by Gibson, Ivancevich, and Donnelly (20:525) as:

> The set of characteristics that describe an organization and that (a) distinguish the organization from other organizations, (b) are relatively enduring over time, and (c) influences the behavior of people in the organization.

Many sources theorize a relationship between organizational climate and stress (27:129; 33:37; 10:101; 15:49; 12:556; 34:530; 4:671; 9:12). In fact, Ivancevich and Matteson (27:238) define an "organizational climate stressor" as "an organizational stressor that is generated by the interaction of the people, structure, policies, and goals of an organization." However, very little research has been conducted examining the relationship between organizational climate

and stress. This may be due to the debate in the literature over the meaningfulness of the organizational climate construct (20:524). The following example was the only study found, other than the previous thesis, which has looked at organizational climate as an antecedent of stress.

Kiev and Kohn (30) examined 2,659 top level and middle level managers who were all identified as being members of the American Management Association. Thus, the sample came from a wide range of organizations. Surveys were mailed to subjects measuring 22 factors which have been shown to be sources of stress on the job. For both middle level and top level managers, the factor with the greatest occurence based on the mean response from a Likert scale was organizational climate. Additionally, each respondent was asked to check the three factors which he felt were the most stress-provoking. Again, organizational climate was the factor most often selected by both middle and top level management. When the respondents were broken into subgroups by function and size of company, it was found that financial managers and executives in larger organizations were bothered more by organizational climate than their counterparts.

In an extensive review of the literature concerning organizational climate, Hellriegel and Slocum (22:263) state that organizational climate clearly has a significant relationship with job satisfaction and performance. Numerous studies are cited to support this statement. Unfortunately, the review found no studies which investigated the relationship between organizational climate and stress. It may be noteworthy to mention, however, that perceived

job stress has been shown to be significantly related to job satisfaction and performance in numerous studies (4:688-690). Thus, it is possible that the link between organizational climate and satisfaction/productivity is through perceived stress.

The relationship between organizational climate and stress has received very little attention by researchers. However, the two studies which did investigate this relationship both found a negative relationship between organizational climate and perceived stress (as organizational climate got worse, perceived stress increased). Also, Fye and Staton (19:95) found that organizational climate was positively related to cortisol level and HDL, and negatively related to the total cholesterol/HDL ratio. In spite of the relative lack of research concerning organizational climate and stress, proponents of stress models continue to include the construct as a stressor. Clearly, the relationship between organizational climate and stress deserves further research.

Individual Factors

Locus of Control

Locus of control is the degree to which a person feels he or she has control over their lives. It is split into two dimensions, internals and externals. Internals believe they have control over their lives, while externals believe that their lives are controlled by others, chance, luck, or fate. (3:261) In 1966, Lazarus (1:195) theorized that externals will perceive greater stress

in stressful situations than will internals. This theory has been borne out by research (3:268; 2:446; 28:625; 1:202). Two examples of the research conducted will be given.

Anderson, Hellriegel, and Slocum (3:260) investigated the relationship between locus of control and perceived stress among 90 small business owners. The subjects lived in a Pennsylvania community which had been flooded due to Hurricane Agnes. The flooding of the town served to induce a stressful situation for small business owners. Data was collected by questionnaire and interview 8 months after the disaster. Spearman rank order correlations indicated that internals perceived less stress than externals ($r = 0.61$, $p < 0.01$). These results were validated by a follow-up study conducted by Anderson (2:446) three and one-half years after the flooding. Again, externals were more likely to perceive high stress ($p < 0.001$).

Abdel-Halim (1:193) examined the joint moderating effect of locus of control and job enrichment on satisfaction and propensity to leave. The independent variable used was role ambiguity. The sample consisted of 89 managerial personnel in a manufacturing firm. Data was collected by questionnaire and analyzed using moderated regression equations. The results indicated that both individual and organizational factors should be considered when analyzing the reactions of people to role ambiguity. In particular, externals in unenriched jobs responded more negatively to role ambiguity than internals in enriched jobs. Further, Abdel-Halim found that internals are more effective in dealing with stressful situations due to

role ambiguity. This agreed with the finding of Szilagyi, Sims, and Keller (42:259), who reached the same conclusion while investigating role conflict.

The relationship between locus of control and perceived stress is well supported. Basically, it has been shown that persons with an external locus of control perceive more stress than persons with an internal locus of control. Also, the person-environment situation plays a role in this relationship. Again, however, this theory has not been extended to CHD risk factors.

Type A/B Behavior Patterns

Two medical researchers, Ray H. Rosenman and Meyer Friedman, have isolated two distinct behavior patterns, Type A and Type B, which are related to CHD. Davidson and Cooper (12:569) describe these behavior patterns as follows:

> Type A behavior is characterized by high achievement, motivation, striving, hard driving competitiveness, time urgency, and many other activities which involve a tendency to suppress fatigue in order to meet deadlines . . . Type B behavior, on the other hand, is characterized by the relative absence of the behavior associated with Type A persons, i.e., ability to relax without guilt, no free-floating hostility, no sense of time urgency, and so on.

Rosenman and Friedman have shown that Type A behavior patterns are related to CHD (36:89) as well as to CHD risk factors (16:1286). In the Western Collaborative Group Study, Friedman, Rosenman, Wurm, Kositchek, Hahn, and Werthessen (18:15) investigated behavioral characteristics and their ability to predict CHD. During the period June 1960 to December 1961, a sample of 3,524 males employed in eleven

corporations were studied. Blood samples and cardiovascular data were obtained for all subjects. Additionally, behavior patterns were assessed through a thirty minute interview and a psychophysiological test. A diagnosis of manifest CHD was made by the senior medical referee based on the blood and cardiovascular data. Two and one-half years later, a follow-up survey of the sample (36:86) revealed that 70 subjects had suffered CHD. Furthermore, more than 50 of the 70 who had suffered CHD were originally classified as Type A. Thus, Type A subjects incurred CHD at a rate more than two times as great as Type B subjects. Additionally, Type A behavior pattern was more predictive of CHD than blood pressure, cholesterol level, or triglycerides. These findings were substantiated in two additional follow-ups, one at the four and one-half year point and the other after eight and one-half years (27:183).

Caplan and Jones (7:713) examined the relationship between workload and anxiety in both Type A and Type B subjects. They selected as subjects 73 computer users in a large university. The stressful situation was generated when the computer had to be shutdown for 23 days. Prior to shutdown, the subjects were administered questionnaires and their heart rates were taken. Positive relationships were found between anxiety and heart rate. The researchers found that the correlations between workload and anxiety were greater for Type A subjects than for Type B subjects. The correlation between anxiety and heart rate was also greater for Type A subjects, but not significantly higher than the correlation for Type B subjects.

The literature indicates that both age and sex need to be considered when examining Type A/B behavior patterns. For example, Davidson, Cooper, and Chamberlain (13:801) examined the relationship between Type A behavior and perceived stress in women. They sampled 180 female managers listed in Women's Who's Who. Questionnaires were administered which measured perceived stress and Type A/B behavior patterns. The researchers found a positive relationship between Type A scores and age. The highest Type A scores were found in the 41 to 50-year age group. No Type A women were found in the 60-year and over age group. This agreed with previous findings by Howard, Cunningham, and Rechnitzer (26:24), who investigated both men and women and obtained the same results.

Thus, Type A behavior has been shown to be related to both CHD and CHD risk factors, such as cholesterol level. Type A/B behavior has been shown in one study to moderate the relationship between workload and anxiety. However, this was the only study found which simultaneously looked at the job environment and Type A/B behavior.

Cortisol

The level of cortisol has been shown to be positively related to stress. Medical researchers in one study found that cortisol secretions in squirrel monkeys (chosen as representative of man) are stimulated by capture, loud noises, and restraint in a chair (6:961). In another study, men completing a 16-week Navy Underwater Demolition Team (UDT) training course were examined.

The UDT course provided periods of intense physical and psychological stress. The researchers found that "the overall stress of UDT training was best reflected by the elevated mean cortisol levels of all the men (38:817)."

Another study examined cortisol levels in Type A and Type B persons during periods of understimulation and overstimulation (31:79). Men and female college students were used in an experimental study. Type A/B behavior patterns were measured by questionniare. Understimulation and overstimulation were induced by mental tasks given in a laboratory setting. Cortisol levels were obtained by urine analysis immediately following the study periods, as well as a baseline analysis conducted during a resting condition. Comparison of the baseline with the experimental situations revealed that cortisol levels of Type A individuals were higher than those of Type B individuals during periods of understimulation. This difference did not exist during overstimulation.

Thus, the positive relationship between cortisol level and stress has been moderately supported. Further, there is some evidence that this relationship is more pronounced in Type A persons than in Type B persons.

CHD Risk Factors

The relationship between stress and CHD risk factors has already been discussed in the introduction to this paper. Likewise, any relationships between CHD risk factors and organizational/individual factors were discussed earlier in this literature review.

The purpose of this section is merely to point out the demographic variables (age, sex, and exercise) which have been shown to be related to CHD risk factors.

Total Cholesterol

Two demographic variables, age and sex, need to be considered when investigating total cholesterol levels. In an excellent paper, Allen Johnson (29:52) investigated these two variables in light of six CHD risk factors, including total cholesterol level. The data base used in this study was drawn from the Framingham Heart Study. This study examined over 6,000 persons aged 30-59. During the period 1948-1966, three examinations of these persons were undertaken. A variety of medical data, including total cholesterol level, was collected. The result of the study in 1966 was a set of multiple regression equations for various age/sex groups which predicted the probability of developing CHD within two years. Johnson analyzed this data and concluded that age and sex do play a role in total cholesterol levels. Specifically, he found that up to age 45, men have higher total cholesterol levels than women, but, after age 45, women have higher total cholesterol levels than men. This finding was later confirmed by Haynes and Feinleib (21:138).

In addition to age and sex, a third variable, physical exercise, needs to be considered when investigating total cholesterol levels. In his review of the literature, Kennon Francis (14:172), concludes that total cholesterol levels are lower for physically active males than for inactive males at all age levels.

HDL Cholesterol

At least one demographic variable, exercise, needs to be considered when examining HDL cholesterol levels. Kennon Francis (14:172) concludes that HDL cholesterol levels are higher for physically active males than for inactive males at all age levels.

Age has relatively little influence on HDL cholesterol levels. Kennon (14:171) states that HDL cholesterol levels remain relatively constant after age 16.

Total Cholesterol/HDL Cholesterol Ratio

Obviously, as this ratio is merely a mathematical reflection of total cholesterol levels and HDL cholesterol levels, any demographic variables affecting either level must be considered when examining their ratio. However, as total cholesterol levels and HDL cholesterol levels may be affected independently, a further point can be made. In a letter to the editors of Atherosclerosis, Malaspina, Bussiere, and Le Calve (32:373-374) state that use of the total cholesterol/HDL cholesterol ratio:

> " . . . permits the avoidance of the misleading interpretation which can occur when patients with relatively low total cholesterol have a low HDL cholesterol level, or vice versa, when subjects with high total cholesterol have high HDL cholesterol levels."

CHAPTER III

METHODOLOGY

The purpose of this study was to investigate the interaction of organizational and individual factors in terms of stress and CHD risk factors. The organizational factors, individual factors, and perceived stress were measured by a questionnaire named the Stress Assessment Package. The levels of cortisol and CHD risk factors (total cholesterol, HDL cholesterol, and total cholesterol/HDL cholesterol ratio) were measured by blood analysis. Factor analysis was used to associate questions with constructs. Reliability of the construct scales was measured by computing Cronbach's alpha. Multiple regression techniques were used to test hypotheses and answer research questions. Finally, analysis of variance procedures were used to investigate relationships indicated by significant organizational stressor/individual trait interactions.

Subjects

The sample consisted of 420 active duty Air Force members and Department of Defense civilian employees. The Air Force bases sampled and number of participants at each base were as follows:

Eglin AFB, Florida	203
Wright-Patterson AFB, Ohio	93
Kelly AFB, Texas	37
Metropolitan Hospital, San Antonio, Texas	24
Reese AFB, Texas	63
	420

These subjects were voluntary participants obtained through advertisements placed in various types of media on several Air Force bases. Stress seminars were held to collect data at all bases except Reese AFB, where questionnaires were administered through the mail. Nine questionnaires were unusable, which meant there were 411 cases available for analyses. There were 304 male subjects and 99 female subjects (9 subjects did not indicate sex). Ages ranged from under 20 years old to over 50 years old.

Blood samples were drawn from all voluntary subjects except at Reese AFB which was sampled through the mail. A total of 351 cases with blood data were available for analysis.

Measures

Questionnaire

A 139 item questionnaire was used to measure organizational factors, individual factors, perceived stress, and demographic characteristics. The questionnaire is contained in Appendix A. The development of the factors contained in the questionnaire of interest to this study is summarized below. Fye and Staton (19:64-68) have previously reported the development of the entire questionnaire.

The questions measuring role conflict and organizational climate were taken from the Organizational Assessment Package developed by Hendrix and Halverson (23). The questions measuring locus of control were developed from Rotter's (37:20) scale as modified by Valencha (43:6).

The questions measuring Type A/B behavior patterns were developed by Fye and Staton (19:67). They based their questions on the characteristics shown in the literature to be related to Type A/B behavior patterns.

Perceived job stress was measured by the following question developed by Fye and Staton (19:68):

"My job causes me a great deal of stress and anxiety." There were seven categories of response, ranging from "strongly agree" to "strongly disagree."

Blood Analysis

All blood samples taken were analyzed at the USAF School of Aerospace Medicine, Brook AFB, Texas. The analysis included measurement of total cholesterol, HDL, and cortisol levels. Fye and Staton (19:69-70) present a detailed description of the techniques used to measure each of these items.

Statistical Procedures

Factor analysis had previously been conducted on 363 questionnaires by Fye and Staton (19:71). However, the addition of 48 cases from Reese AFB meant the procedure had to be reaccomplished.

Factor analysis was conducted on 411 questionnaires in order to determine construct validity. Orthagonal rotation (Varimax) was used. All questions except those dealing with demographic data were factor analyzed simultaneously. The factor analysis originally included a listwise deletion of missing data. This

meant that if a questionnaire had an invalid response, the entire questionnaire was deleted from the analysis. Because this method substantially reduces the number of cases in the analysis, it was followed by a pairwise deletion of missing data. Using pairwise deletion, the case is only deleted when a missing value is encountered for a question in the computation of correlation coefficients. This method utilized the maximum possible number of cases in the analysis. In this instance, both methods yielded the same results, so no distinction will be drawn between them in later discussions.

Factor analysis was only used to identify the questions to be used in building construct scales. This was followed by the computation of reliability coefficient, Cronbach's alpha, for each construct. The statistical package used included the capability to determine the Cronbach alpha value if a question was deleted from the scale. In this way, further refinement of the questions used in building construct scales was possible.

The next step was to perform multiple regression analysis. One model was built for all dependent variables. This model included the main effects of role conflict, organizational climate, locus of control, and Type A/B behavior pattern, as well as all associated two and three way interaction terms. The main effects of role conflict, organizational climate, locus of control and Type A/B behavior pattern were generated by computing the mean response for all questions used in building each construct. The interaction terms were obtained by multiplying the scores for main effects.

In addition, the model controlled for sex, age, and jogging. This procedure, controlling for sex, age, and jogging, was not used by the previous research team.

The first multiple regression procedure employed was a stepwise procedure. First, the main effects and control variables entered into the equation. The statistical package used included the capability to remove a variable once it had entered if it was no longer significant in the presence of other variables. However, this capability was only extended to the interaction terms. All control variables and main effects were forced to remain in the equation, whether they were significant or not. In this way, the main effects were essentially control variables themselves.

The stepwise multiple regression was checked by performing backward elimination. In this procedure, all variables were entered into the equation on the first step. Next, any interaction terms which were not significant were removed from the equation. Again, the control variables and main effects were forced to remain in the equation. Because the stepwise procedure and the backward elimination yielded the same results, no distinction will be drawn between them in the future discussions.

Finally, an analysis of variance (ANOVA) procedure was used to investigate the relationships involved in any interaction term which was found to be significant by the multiple regression. The ANOVA procedure included Duncan's multiple range test. For this

test, the constructs were divided into highs and lows at their mean plus and minus one-half standard deviation and significant differences in the cell means for the dependent variable were examined.

CHAPTER IV

ANALYSIS

The purpose of the analysis section is to discuss the results of the factor analysis, reliability tests, multiple regression analyses, and analyses of variance.

Factor Analysis and Reliability

The factor analysis of 411 Stress Assessment Package questionnaires resulted in fifteen factors being identified. Of these fifteen, four were used for this study: role conflict, organizational climate, locus of control, and Type A/B behavior pattern. The questions loading on each of the factors will be identified in the following discussion. These questions are contained in the Stress Assessment Package (Appendix A).

Role Conflict

There were four variables loading on this factor: questions 84, 85, 90, and 92. These questions measured the degree to which the subjects felt: (1) they could perform their job better if their organization had less rules, (2) they had to do things that should be done differently, and (3) they had inadequate manpower to complete their job. The reliability for this scale, measured in terms of Cronbach's alpha, was 0.79.

Organizational Climate

There were three variables loading on this factor: questions 73, 74, and 77. These questions measured the degree to which the subjects felt: (1) their organization was interested in their job attitude, (2) their organization was interested in the welfare of its people, and (3) their organization gave rewards based on performance. The reliability for this scale, measured in terms of Cronbach's alpha, was 0.85.

Locus of Control

There were eight variables loading on this factor: questions 2, 4, 5, 6, 7, 8, 10, and 11. These questions measured the degree to which the subjects felt: (1) they get the respect they deserve, (2) becoming a success was a matter of hard work rather than luck, (3) the extent to which luck controlled their lives, and (4) the amount of control they had over their lives. The reliability of this scale, measured in terms of Cronbach's alpha, was 0.75.

Type A/B Behavior Pattern

There were eight variables loading on this factor as a result of the factor analysis: questions 15, 16, 17, 18, 19, 21, 22, and 23. However, the results of the reliability analysis revealed that the reliability of the scale would be improved if question 16 were deleted, which was done. The remaining seven questions measured the degree to which the subjects felt: (1) they were continually moving some part of their body, (2) they disliked waiting, (3) they

frequently got upset with people, (4) they were always in a hurry, (5) they set high standards and were upset by non-attainment, (6) they tried to do too much and were tired as a result, and (7) they ate too fast. The reliability of this seven question scale, measured in terms of Cronbach's alpha, was 0.73.

Multiple Regression Analysis

This section discusses the results of all multiple regression analyses performed. It is important to emphasize that during these analyses the main effects of role conflict, organizational climate, locus of control, and Type A/B behavior pattern were forced to remain in the equation whether they were significant or not. Additionally, the control variables, age, sex, and jogging, were also forced to remain in the equation.

The research hypotheses indicated relationships between the main effects of organizational stressors/individual traits and perceived job stress/CHD risk factors. The research questions examined the relationship between the interaction of organizational stressors/individual traits and perceived job stress/CHD risk factors. The interaction was generated by multiplying the subjects' scores for main effects. The multiple regression analyses allowed simultaneous investigation of the research hypotheses and research questions. Thus, the results reflect all research hypotheses and research questions. Each section will discuss all dependent variables, which were perceived job stress, cortisol level, total

cholesterol level, HDL cholesterol level, and the total cholesterol/HDL cholesterol ratio.

Total Sample (n = 311)

Two main effects, role conflict and Type A/B behavior pattern, were predictive of perceived job stress. One control variable, sex, and one interaction term, role conflict x Type A/B behavior pattern, were predictive of cortisol level. One control variable, age, was predictive of total cholesterol level. Two control variables, sex and jogging, were predictive of HDL cholesterol level. Three control variables, age, sex, and jogging, were predictive of the total cholesterol/HDL cholesterol ratio.

Dependent Variable	Predictor	R	R^2	F	p
Job Stress	Role Conflict	.48	.23	20.8	.001
	Type A/B	.41	.17	33.7	.001
Cortisol	Sex	.12	.01	7.5	.01
	Role Conflict x Type A/B	.23	.05	5.0	.05
Total Cholesterol	Age	.31	.10	26.4	.001
HDL Cholesterol	Sex	.38	.15	60.7	.001
	Jogging	.42	.18	9.7	.01
Ratio	Age	.36	.13	12.2	.001
	Sex	.30	.09	38.6	.001
	Jogging	.41	.17	12.3	.001

The sex variable was extremely predictive of cortisol levels, HDL cholesterol levels, and the total cholesterol/HDL cholesterol ratio. Because of this, the total sample was dichotomized into two sub-samples, males and females. The sex variable was then

removed from the regression equations and multiple regression analyses performed on the male and female samples.

Male Sample (n = 235)

Two main effects, role conflict and Type A/B behavior pattern, and one control variable, age, were predictive of preceived job stress. One control variable, jogging, was predictive of cortisol level. One control variable, age, was predictive of total cholesterol level. One control variable, jogging, was predictive of HDL cholesterol level. Two control variables, age and jogging, were predictive of the total cholesterol/HDL cholesterol ratio.

Dependent Variable	Predictor	R	R^2	F	p
Job Stress	Role Conflict	.39	.15	13.5	.001
	Type A/B	.49	.23	25.0	.001
	Age	.10	.01	6.7	.01
Cortisol	Jogging	.17	.03	5.7	.05
Total Cholesterol	Age	.26	.07	14.8	.001
HDL Cholesterol	Jogging	.25	.06	9.4	.01
Ratio	Age	.24	.06	12.0	.001
	Jogging	.33	.11	10.3	.01

Female Sample (n = 76)

Two main effects, role conflict and Type A/B behavior pattern, and one control variable, jogging, were predictive of perceived job stress. One main effect, role conflict, and one interaction term, role conflict x Type A/B behavior pattern, were predictive of cortisol level. One main effect, organizational climate, and one control variable, age, were predictive of total cholesterol level.

Dependent Variable	Predictor	R	R^2	F	p
Job Stress	Role Conflict	.48	.23	7.4	.01
	Type A/B	.59	.35	14.2	.001
	Jogging	.62	.38	4.3	.05
Cortisol	Role Conflict	.22	.05	4.8	.05
	Role Conflict x Type A/B	.42	.18	5.1	.05
Total Cholesterol	Organizational Climate	.54	.29	8.3	.01
	Age	.42	.18	18.4	.001

In both sub-samples, male and female, the age variable was extremely predictive of total cholesterol levels. Because of this, the male sample was dichotomized into two further sub-samples, males who were 40 years old or younger, and males over 40 years old. Unfortunately, the size of the female sample did not allow this sample to be dichotomized. Multiple regression analyses were preformed on the two male sub-samples. All variables, including age, remained in the equation.

Males 40 Years Old or Younger (n = 107)

Two main effects, role conflict and Type A/B behavior pattern, were predictive of perceived job stress. One control variable, age, was predictive of total cholesterol level. And one control variable, age, was predictive of the total cholesterol/HDL cholesterol ratio.

Dependent Variable	Predictor	R	R^2	F	p
Job Stress	Role Conflict	.50	.25	11.4	.001
	Type A/B	.31	.10	5.0	.05
Total Cholesterol	Age	.22	.05	4.0	.05
Ratio	Age	.22	.05	4.5	.05

Males Over 40 Years Old (n = 128)

Three main effects, role conflict, organizational climate, and Type A/B behavior pattern, were predictive of perceived job stress. One control variable, jogging, was predictive of cortisol level. One main effect, role conflict, was predictive of total cholesterol level. One control variable, jogging, was predictive of HDL cholesterol level. And one main effect, jogging, was predictive of the total cholesterol/HDL cholesterol ratio.

Dependent Variable	Predictor	R	R^2	F	p
Job Stress	Role Conflict	.35	.12	4.2	.05
	Organizational Climate	.53	.28	5.1	.05
	Type A/B	.50	.25	18.5	.001
Cortisol	Jogging	.26	.07	8.3	.01
Total Cholesterol	Role Conflict	.20	.04	5.5	.05
HDL Cholesterol	Jogging	.40	.16	21.5	.001
Ratio	Jogging	.35	.12	15.3	.001

Analysis of Variance

Analysis of variance was used to investigate the interaction term, role conflict x Type A/B behavior pattern, which was predictive of cortisol level in the total sample and the female sample. The constructs were divided into highs (Type B/high role conflict) and lows (Type A/low role conflict) at their mean plus and minus one-half standard deviation and significant differences in the four cell means for the dependent variable, cortisol, were examined. No significant differences were found. This may have been because the

cell sizes were too small. For this reason, the constructs were divided into highs and lows at their means and then analyzed. Again, no significant differences were found. One reason could be that the cell sizes were still too small. Another possible explanation is that the cells had unequal sizes. Duncan's multiple range test results in only an approximate solution when it encounters unequal cell sizes.

CHAPTER V

CONCLUSIONS

This chapter discusses the results of this study. One objective of this study was to verify the hypotheses suggested by the results of the previous research effort. These findings will be presented first. It is important to emphasize that the regression equations in this study controlled for the effects of sex, age, and jogging. The previous research effort did not control for these effects. Next, the results relating to the primary purpose of this research effort, the examination of the joint effect of organizational stressors and individual traits on stress responses and CHD risk factors, will be addressed. Finally, the results obtained relevant to the control variables, sex, age, and jogging, will be discussed. The findings are summarized in Table 1.

Role Conflict

There was one research hypothesis offered concerning the construct role conflict. That hypothesis stated that role conflict is positively related to perceived job stress. This relationship was found to be true for all samples and sub-samples analyzed. Thus, as role conflict increases, perceived job stress increases. This relationship was not affected by the subjects' sex or age.

Table 1. Relationships Between Independent Variables and Dependent Variables

Total Sample (n=311)

	Role Conflict	Organizational Climate	Locus of Control	Type A/B Behavior Pattern	Role Conflict x Type A/B	Age	Sex	Jogging
Job Stress	P[a]			P/N[a*]				
Cortisol					N[c]		P[b]	
Total Cholesterol						P[a]		
HDL Cholesterol							N[a]	P[b]
Ratio						P[a]	P[a]	N[a]

Male Sample (n=235)

	Role Conflict	Organ. Climate	Locus of Control	Type A/B	Role Conflict x A/B	Age	Jogging
Job Stress	P[a]			P/N[a*]		P[b]	
Cortisol							N[c]
Total Cholesterol						P[a]	
HDL Cholesterol							P[b]
Ratio						P[a]	N[b]

Female Sample (n=76)

	Role Conflict	Organ. Climate	Locus of Control	Type A/B	Role Conflict x A/B	Age	Jogging
Job Stress	P[b]			P/N[a*]			P[c]
Cortisol	P[c]				N[c]		
Total Cholesterol		P[b]				P[a]	
HDL Cholesterol							
Ratio							

Male Under 40 Sample (n=107)

	Role Conflict	Organ. Climate	Locus of Control	Type A/B	Role Conflict x A/B	Age	Jogging
Job Stress	P[a]			P/N[c*]			
Cortisol							
Total Cholesterol						P[c]	
HDL Cholesterol							
Ratio						P[c]	

Male Over 40 Sample (n=128)

	Role Conflict	Organ. Climate	Locus of Control	Type A/B	Role Conflict x A/B	Age	Jogging
Job Stress	P[c]	N[c]		P/N[a*]			
Cortisol							N[b]
Total Cholesterol	N[c]						
HDL Cholesterol							P[a]
Ratio							N[a]

P=Positive Relationship
N=Negative Relationship

a=p < .001
b=p < .01
c=p < .05

*In all samples, there was a positive relationship between Type A behavior pattern and perceived job stress and a negative relationship between Type B behavior pattern and perceived job stress.

Additionally, it was found in the female sub-sample that role conflict was positively related to cortisol level. As role conflict increased, the female's cortisol level increased.

Lastly, it was found that role conflict was negatively related to total cholesterol level in the male over 40 years old sub-sample. This finding is interesting as it is contrary to any stress model.

Organizational Climate

There was two research hypotheses concerning the organizational climate construct. One hypothesis stated that organizational climate is negatively related to perceived job stress. The only sample analyzed in which this relationship was found was the male over 40 years old sample. This finding suggests that the relationship between organizational climate and perceived job stress may be affected by both sex and age.

The second hypothesis stated that organizational climate is negatively related to the total cholesterol/HDL cholesterol ratio. This relationship was not found in any sample analyzed. One possible explanation for this discrepancy between this study and the previous study is that the control variables sex, age, and jogging were used in this study, while they were not used previously.

In addition, a positive relationship was found between organizational climate and total cholesterol level in the female sample. Again, there is no precedent for such a relationship.

Type A/B Behavior Patterns

There was one research hypothesis concerning Type A/B behavior patterns. This hypothesis stated that Type A behavior was positively related to perceived job stress. This relationship was found to be true in every analysis. Thus, regardless of sex or age, a Type A behavior pattern is positively related to perceived job stress. Also, a Type B behavior pattern is negatively related to perceived job stress.

Locus of Control

The previous study found a significant relationship between locus of control and perceived job stress. This relationship was supported by the literature. Thus, it was hypothesized that external locus of control is positively related to perceived job stress. This relationship was not found in any analysis. This could be due to the dependence between locus of control and stress in the theory. Lazarus' theory (1:195) states that externals will experience greater stress in a stressful situation than will internals. Therefore, a stressful situation must be generated when testing this theory. Interestingly, this type of situation could have been generated by the interaction of locus of control and role conflict in this study. However, no significant relationship was found.

Combinations of Organizational Stressors and Individual Traits

The five research questions in this study asked what combinations, or interactions, of organizational stressors and individual

traits were predictive of perceived job stress and CHD risk factors. These interactions were generated by multiplying the subjects' responses to the main effects together. Significant interaction terms were allowed to enter the regression equation only after the main effects and control variables had entered. Give this constraint, only one significant interaction term was found.

The interaction of role conflict and Type A/B behavior pattern was negatively related to cortisol level. This relationship was first discovered when analyzing the entire sample. However, after dichotomizing the sample into males and females, the relationship was only significant in the female sample. Unfortunately, the analysis of variance conducted on this interaction term did not find any significant differences in mean cortisol levels for persons who were Type A in high role conflict jobs, persons who were Type A in low role conflict jobs, persons who were Type B in high role conflict jobs, or persons who were Type B in low role conflict jobs. Because of this, no conclusion can be drawn concerning the interaction effect of Type A/B behavior pattern and role conflict on cortisol level

Sex

In the total sample, the subjects' sex was significantly related to cortisol level, HDL cholesterol level, and the total cholesterol/HDL cholesterol ratio. The relationship between sex and cortisol indicated that males have higher cortisol levels than

females. However, women had lower HDL cholesterol levels than men. Also, men had higher total cholesterol/HDL cholesterol ratios than women. This seems to indicate that men have higher total cholesterol levels than women. However, no such relationship was found. This could be due to the interaction effect of age and sex.

Age

The subjects' age was significantly related to total cholesterol level and the total cholesterol/HDL cholesterol ratio in the total sample. After dichotomizing the total sample by age and sex, the positive relationship between age and total cholesterol level was found for males, females, and males 40 years old and younger. Interestingly, no relationship was found between age and total cholesterol level in the men over 40 years old group. This appears to support Johnson's (29:52) findings that up to age 45, men have higher cholesterol levels than women, but after age 45, women have higher cholesterol levels than men.

The subjects' age was significantly related to perceived job stress in the male sample. This indicated that as men grow older, they preceive more stress in their work.

Lastly, the subjects' age was significantly related to the total cholesterol/HDL cholesterol ratio in the male sample and the male under 40 years old sample. This is probably merely a reflection of the positive relationship between age and total cholesterol

discussed above. If so, it also supports Kennon's (14:171) statement that after age 16, HDL cholesterol levels remain fairly constant.

Jogging

Jogging was found to be positively related to perceived job stress in the female sample. This finding conflicted with those of the previous research team and previous theory.

However, jogging was negatively related to cortisol level in the male sample. Additionally, jogging was positively related to HDL cholesterol level and negatively related to the total cholesterol/ HDL cholesterol ratio in the total sample, the male sample, and the male over 40 years old sample. The fact that these results were found for males may indicate that more men than women jog. However, the results definitely indicate that jogging may lower the risk of CHD potential.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS FOR FUTURE RESEARCH

This research examined the joint effect of organizational stressors and individual traits on stress responses and CHD risk factors. The study began by attempting to verify the results obtained by a previous research team using basically the same data base. However, the methodology employed in this study differed from that of the previous study. All regression equations controlled for the effects of age, sex, and jogging. These variables have been identified by previous studies as predictive of CHD risk factors. These findings were confirmed by this study. However, the inclusion of these control variables led to an inability to verify the results obtained by the previous research team.

The significance of this finding cannot be overemphasized. There are a variety of theorized antecedents of stress and CHD risk factors, many of which are strongly supported in the literature. Any attempt to further explain the relationship between stressors, or antecedents of stress, and both stress and CHD risk factors must include the maximum possible number of proposed stressors and control variables. The identification of additional stressors should be attempted only after the effects of previously identified stressors and control variables have been removed.

The primary purpose of this study was to examine the joint effect of organizational stressors and individual traits on stress and CHD risk factors. Only one such combination was found. However, this study constructed the combinations by multiplying the subjects' response to main effects. It may be that the combined effect is not multiplicative. Rather, it could be additive or any other mathematical combination. This study does not eliminate the possibility that combinations of organizational stressors and individual traits are significant predictors of stress and CHD risk factors. Rather, it indicates that, for the specific sample studied, there is only one multiplicative combination which is significantly predictive of cortisol level after controlling for main effects.

Lastly, the statistical procedures employed by this research are by no means the only avenue to follow. Specifically, the ANOVA technique was hampered by using unequal cell sizes. One method of overcoming this difficulty would be to categorize subjects as having various degrees of individual traits and organizational stressors. Next, equal random samples could be drawn from each category and then analyzed. This is only one suggestion. Obviously, a great many procedures and statistical techniques could be employed.

APPENDICES

APPENDIX A

STRESS ASSESSMENT PACKAGE

The Stress Assessment Package (SAP) is a tool designed to aid in measuring your personal stress level and determine some of the organizational components that may contribute to stress.

You will find the terms work group, organization, and supervisor used extensively as you complete this questionnaire. The term work group refers to a group of individuals working for the same supervisor, while the term organization refers to the overall organizational unit. For example, if your composition is within a section of a squadron then the squadron is your organization and your section is your work group.

With the exception of the Background Information Section, three types of scales are used in the SAP. Most of the sections will have a seven-point (1-7) scale; with one section having a six-point (1-6) scale. There are, however, four sections that have an eight-point (1-8) scale. In these cases the 8 would be marked if the item is not applicable to you. Mark your answers on the separate answer sheet provided. PLEASE USE A NUMBER 2 PENCIL ONLY. Make heavy black marks that completely fill the appropriate space. For example, using the scale below, if you strongly agree with item statement 1 then you would blacken the 7 space on the answer sheet as shown in the example below.

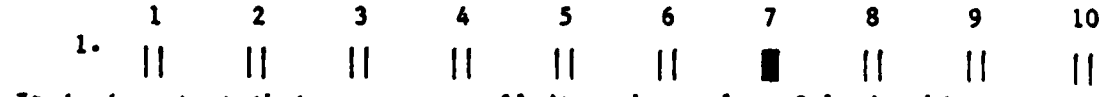
Scale:

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Neither agree nor disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree
8 = Not applicable

Item Statement:

1. My supervisor is a good planner.

Answer Response:



It is important that you answer all items honestly. Only in this way can an accurate stress assessment be made.

Your individual responses will be held in the strictest confidence, and will not be provided to any organization or persons. Only those directly involved in this research will have access to your completed SAP.
DO NOT STAPLE OR OTHERWISE DAMAGE THE ANSWER SHEET.

PERSONAL BELIEFS

Instructions

This portion of the questionnaire relates the way in which certain important events in our society affect different people. Each item consists of a pair of alternatives numbered 1 or 2. Using the scale below, indicate which statement most closely follows your own beliefs, and record it on your answer sheet.

1 = I strongly agree more with statement 1
2 = I moderately agree more with statement 1
3 = I slightly agree more with statement 1
4 = I slightly agree more with statement 2
5 = I moderately agree more with statement 2
6 = I strongly agree more with statement 2

1. 1 Children get into trouble because their parents punish them too much.
   2 The trouble with most children nowadays is that their parents are too easy with them.

2. 1 In the long run people get the respect they deserve in this world.
   2 Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

3. 1 The idea that teachers are unfair to students is nonsense.
   2 Most students don't realize the extent to which their grades are influenced by accidental happenings.

4. 1 Becoming a success is a matter of hard work; luck has little or nothing to do with it.
   2 Getting a good job depends mainly on being in the right place at the right time.

5. 1 The average citizen can have an influence in government decisions.
   2 This world is run by the few people in power, and there is not much the little guy can do about it.

6. 1 In my case, getting what I want has little or nothing to do
   2 Many times we might just as well decide what to do by flipping a coin.

7. 1 Getting people to do the right thing depends upon ability; luck has little or nothing to do with it.
   2 Who gets to be the boss often depends on who was lucky enough to be in the right place first.

1 = I strongly agree more with statement 1
2 = I moderately agree more with statement 1
3 = I slightly agree more with statement 1
4 = I slightly agree more with statement 2
5 = I moderately agree more with statement 2
6 = I strongly agree more with statement 2

8. 1 There is really no such thing as luck.
   2 Most people don't realize the extent to which their lives are controlled by accidental happenings.

9. 1 Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.
   2 In the long run the bad things that happen to us are balanced by the good ones.

10. 1 It is impossible for me to believe that chance or luck plays an important role in my life.
    2 Many times I feel that I have little influence over the things that happen to me.

11. 1 What happens to me is my own doing.
    2 Sometimes I feel that I don't have enough control over the direction my life is taking.

PERSONAL ATTRIBUTES
Instructions

The next set of questions is concerned with your personal attributes. Each item consists of five alternatives. Select the alternative that is the most descriptive of you as an individual. Please record your answer on the answer sheet.

12. 1 No other activities give me as much satisfaction as my job.
    2 My primary satisfaction comes from my job but I do enjoy non-work activities.
    3 I get equal satisfaction from my job and non-work activities.
    4 My primary satisfaction comes from non-work activities, although I do enjoy my job.
    5 All of my satisfaction comes from activities outside the work environment.

13. 1 Winning is everything; my satisfaction comes from winning.
    2 I like winning any game or event, and am very disappointed when I lose.
    3 I like winning any game or event, and am somewhat disappointed when I lose.
    4 I like winning any game or event, but I equally enjoy the social interaction and participation.
    5 I enjoy the social interaction and participation that comes with a game or event, and losing does not bother me at all.

14. 1 I do my very best when I'm fighting a tight deadline.
2 I seem to do my best work when I have a reasonable deadline to meet.
3 I work equally well whether I have a deadline to meet or not.
4 Although I perform adequately with a deadline to meet, I prefer to not meet a deadline.
5 I do not like deadlines; I do my best work when I'm not hurried in any manner.

15. 1 I am constantly moving some part of my body, such as tapping my foot or drumming my fingers, even when I am sitting down.
2 When I sit down, I usually drum my fingers, play with a pencil, tap my foot, or fidget in other ways.
3 When I sit down, I occasionally drum my fingers, play with a pencil, tap my foot, or fidget in other ways.
4 When I sit down, I seldom drum my fingers, play with a pencil, tap my foot, or fidget in other ways.
5 I totally relax when I sit down. I can sit for extended periods without the slightest movement.

16. 1 I tend to be extremely competitive and hard-driving in everything that I do.
2 I tend to be moderately competitive and hard-driving in everything that I do.
3 I tend to be somewhat competitive and hard-driving in most of my activities.
4 I tend to be relaxed and noncompetitive in the majority of my activities.
5 The more relaxed and noncompetitive I can be, the more I can enjoy whatever it is I do.

17. 1 I hate to wait on anything or anybody.
2 I do not enjoy waiting but I will if I absolutely have to.
3 Although I don't really enjoy waiting, I don't mind it if I don't have to wait too long.
4 I don't mind waiting; there are many situations where one must wait.
5 Waiting on something or someone is a pleasant opportunity to relax.

18. 1 I very frequently get very upset and angry with people, but I don't show it.
2 I frequently get upset and angry with people, but I may not show it.
3 I sometimes get upset or angry with people, and most of the time I will express my anger to them.
4 I rarely get upset or angry with people, but when I do, I always express my feelings freely.
5 I very rarely get upset with anyone; most incidents aren't worth getting angry over.

19. 1 I am always in a rush, even when I don't have to be.
2 Most of the time I'm in a hurry, even when I don't have to be.
3 I occasionally find myself in a hurry, even though most of the time I don't have to.
4 I seldom hurry myself; only when I have to.
5 I will not hurry myself, even when I know I'm late.

20. 1 I would like for people to respect me primarily because of the things I accomplish.
2 I would like for people to respect me for who I am, but more importantly, for what I accomplish.
3 I want to be respected for who I am and what I accomplish.
4 I would like for people to respect me for what I accomplish, but more importantly, for who I am.
5 I would rather be respected for who I am, not what I accomplish.

21. 1 I set very high work standards for myself, and get very upset when I don't meet them.
2 I set high work standards for myself, and get upset when I don't meet them.
3 I set my own work standards, and it bothers me somewhat if I don't meet them.
4 I set work standards for myself, and it bothers me to a little extent if I don't meet them.
5 I maintain work standards that I can make without overextending myself, and I do not get upset if I occasionally fail.

22. 1 I always try to do too much, as a result I always feel tired.
2 I frequently try to do too much, and as a result I feel tired most of the time.
3 On rare occasions I find myself trying to do too much; when these occasions arise, I slow down.
4 I pace myself in accomplishing tasks so that they are all accomplished with the minimum amount of fatigue.
5 I will not overextend myself, even if it means not getting something done.

23. 1 I eat very fast, because I feel that meals waste too much of my time.
2 I eat fast, because sometimes I feel that I could put the time I spend eating to better use.
3 I eat at a moderate pace.
4 I eat slowly, because I can enjoy the meal more that way.
5 I eat very slowly; the more slowly and relaxed I eat, the better I enjoy my meals.

PERCEIVED PRODUCTIVITY
Instructions

The statements below deal with the output of your group. For some jobs certain statements may not be applicable. Should this be the case for your work group, then you should select the not applicable statement coded "8" below. Indicate your agreement with the statement by selecting the answer which best represents your attitude concerning your work group.

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Neither agree nor disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree
8 = Not applicable

24. The quality of output of your work group is very high.

25. When high priority work arises, such as short suspenses, crash programs, and schedule changes, the people in my work group do an outstanding job in handling these situations.

26. Your work group's performance in comparison to similar work groups is very high.

27. The quantity of output of your work group is very high.

JOB INVENTORY
Instructions

Below are items which relate to your job. Read each statement carefully and then decide to what extent the statement is true of your job. Indicate the extent that the statement is true for your job by choosing the statement below which best represents your job.

1 = Not at all
2 = To a very little extent
3 = To a little extent
4 = To a moderate extent
5 = To a fairly large extent
6 = To a great extent
7 = To a very great extent

Select the corresponding number for each question and enter it on the separate answer sheet.

28. To what extent does your job provide a great deal of freedom and independence in scheduling your work and selecting your own procedures to accomplish it?

29. To what extent does your job give you freedom to do your work as you see fit?

30. To what extent do you use your time to plan for more than 6 months ahead?

1 = Not at all
2 = To a very little extent
3 = To a little extent
4 = To a moderate extent
5 = To a fairly large extent
6 = To a great extent
7 = To a very great extent

31. To what extent do you use your time for weekly or monthly planning?

32. To what extent do you use your time for daily planning?

33. To what extent are you aware of promotion/advancement opportunities that affect you?

34. To what extent is your work group involved in establishing goals?

35. To what extent do you have the opportunity to progress up your career ladder?

36. To what extent are you being prepared to accept increased responsibility?

37. To what extent do people who perform well receive recognition?

38. To what extent is there conflict between your work group and another work group in your organization?

39. To what extent is there conflict between your organization and another organization with which you have some work-related dealings?

40. To what extent are your job performance goals realistic?

41. To what extent does your job provide you with the chance to finish completely the piece of work you have begun?

42. To what extent do you feel as though too many people depend upon you too much of the time?

43. To what extent do your work responsibilities change over time?

44. To what extent do you have adequate tools and equipment to accomplish your job?

45. To what extent are you proud of your job?

46. To what extent does your job give you a feeling of pride and self-worth?

47. To what extent does doing your job well affect a lot of people?

48. To what extent is your job significant, in that it affects others in some important way?

49. To what extent does your job require you to do many different things, using a variety of your talents and skills?

50. To what extent is your work group involved in establishing goals?

51. To what extent are your job performance goals clear and specific?

52. To what extent does your job provide the chance to know for yourself when you do a good job, and to be responsible for your own work?

53. To what extent do you know exactly what is expected of you in performing your job?

54. To what extent would you like to have the opportunity for personal growth in your job?

55. To what extent would you like to have the opportunity to use your skills in your job?

56. To what extent would you like to have the opportunity to perform a variety of tasks in your job?

57. To what extent are the requirements placed on you in your job in line with your interests and values?

58. To what extent does your present job fulfill your expectations of what a good job involves?

SUPERVISOR INVENTORY

Instructions

The statements below describe characteristics of managers or supervisors. Indicate your agreement by choosing the statement below which best represents your attitude concerning your supervisor.

1 = Strongly disagree	5 = Slightly agree
2 = Moderately disagree	6 = Moderately agree
3 = Slightly disagree	7 = Strongly agree
4 = Neither agree nor disagree	8 = Not applicable

Select the corresponding number and mark your answer on the separate answer sheet.

59. My supervisor is a good planner.

60. My supervisor represents the group at all times.

61. My supervisor establishes good work procedures.

62. My supervisor has made his responsibilities clear to the group.

63. My supervisor performs well under pressure.

64. My supervisor always helps me improve my performance.

65. My job performance has improved due to feedback received from my supervisor.

66. My supervisor frequently gives me feedback on how well I am doing my job.

67. My relationship with my supervisor is a good one.

ORGANIZATION CLIMATE INVENTORY

Instructions

Below are items which describe characteristics of your organization. Indicate your agreement by choosing the statement below which best represents your opinion concerning your organization.

1 = Strongly disagree	5 = Slightly agree
2 = Moderately disagree	6 = Moderately agree
3 = Slightly disagree	7 = Strongly agree
4 = Neither agree nor disagree	8 = Not applicable

68. Your organization provides all the necessary information for you to do your job effectively.

69. Your organization provides adequate and accurate information to your work group.

70. I could produce a higher quality product, if I only had more time.

71. Quantity seems to be more important to this organization than quality.

72. I never have enough time to adequately complete my assigned tasks.

73. Your organization is very interested in the attitudes of the group members toward their jobs.

74. Your organization has a very strong interest in the welfare of its people.

75. I am very proud to work for this organization.

76. I feel motivated to contribute my best efforts to the mission of this organization.

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Neither agree nor disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree
8 = Not applicable

77. This organization rewards individuals based on performance.

78. I know precisely my role as an employee in this organization.

79. I feel that my peers do not understand what is involved in my job.

80. I view my function within the organization in exactly the same way my peers, subordinates, and superiors view it.

81. I am constantly being instructed to do my job in different ways by different people.

82. I cannot please one superior without displeasing another.

83. My needs are in conflict with those of the organization.

84. There are far too many policies and regulations constricting my effective job performance.

85. I could do my job better if the organization had fewer rules.

86. My relationship with my peers is a good one.

87. There are very few disagreements or conflicts between myself and my co-workers.

88. My job causes me a great deal of stress and anxiety.

89. I work on a job where the required tasks to be performed are like the kinds of tasks I prefer in a job.

90. I have to do things that should be done differently.

91. I receive an assignment without the manpower to complete it.

92. I work on unnecessary things.

93. I receive an assignment without adequate resources and materials to execute it.

JOB SATISFACTION QUESTIONNAIRE
Instructions

The items below relate to your job or the Air Force as a profession. Indicate how satisfied or dissatisfied you are with each item. Choose the statement below which best describes your degree of satisfaction or dissatisfaction.

1 = Extremely dissatisfied
2 = Moderately dissatisfied
3 = Slightly dissatisfied
4 = Neither satisfied nor dissatisfied
5 = Slightly satisfied
6 = Moderately satisfied
7 = Extremely satisfied
8 = Not applicable

94. Feeling of Helpfulness:
The chance to help people and improve their welfare through the performance of your job.

95. Family Attitude Toward Job:
The recognition and the pride your family has in the work you do.

96. Moral Acceptability of Job:
The chance to do things not violating your sense of "right and wrong."

97. Self-improvement Opportunities:
The educational and recreational opportunities provided by the Air Force for self-improvement.

98. Verbal and Written Communication:
The amount of required telephone communication and required paperwork in your job.

99. Work Itself:
The challenge, interest, importance, variety, and feelings of accomplishment you receive from your work.

100. Work Schedule:
Your work schedule; flexibility and regularity of your work schedule; the number of hours you work per week.

101. Job Security

102. Acquired Valuable Skills:
The chance to acquire valuable skills in your job which prepare you for future opportunities.

103. Your Job as a Whole

ASSERTIVENESS INVENTORY
Instructions

The following questions will attempt to measure your level of assertiveness. Indicate your agreement with the statement by selecting the answer which best represents your opinion.

1 = Not at all
2 = To a very little extent
3 = To a little extent
4 = To a moderate extent
5 = To a fairly large extent
6 = To a great extent
7 = To a very great extent

104. To what extent do you call it to his/her attention when a person is highly unfair?

105. To what extent do you speak out or protest when someone takes your place in line?

106. To what extent do you call attention to the situation in which a latecomer is waited on before you?

107. To what extent do you protest a person kicking or bumping your chair in a movie or lecture?

108. To what extent do you insist that your landlord (mechanic, repairman, etc) make repairs that are his responsibility to make?

109. To what extent are you able to speak up for your viewpoint when you differ with a person you respect?

110. To what extent are you able to refuse unreasonable requests made by friends?

BACKGROUND INFORMATION
Instructions

The last section of this survey concerns your background. Please use the separate answer sheet and darken the space which corresponds with your response to each question.

111. If you are an officer, your grade level is:

1	I am not an officer	6	O-5
2	O-1	7	O-6
3	O-2	8	O-7
4	O-3	9	O-8
5	O-4	10	O-9 or above

112. If you are an enlisted person, your grade level is:

1	I am not enlisted	6	E-5
2	E-1	7	E-6
3	E-2	8	E-7
4	E-3	9	E-8
5	E-4	10	E-9

113. If you are a General Schedule (GS) employee, your grade level is:

1	I am not a GS employee	6	09 to 10
2	01 to 02	7	11 to 12
3	03 to 04	8	13 to 14
4	05 to 06	9	15 to 16
5	07 to 08	10	17 or above

114. If you are a Wage Grade (WS or WG) employee, your grade level is:

1	I am not a WS or WG employee	6	09-10
2	01-02	7	11-12
3	03-04	8	13-14
4	05-06	9	15-16
5	07-08	10	16 or above

115. If you are a civilian employee (not employed by the federal government), or Air Force Reservist, which of the following best describes your occupation?

1 Secretary
2 First line supervisor
3 Mid-level manager
4 Upper-level manager (executive)
5 Other

116. Total months in this organization is:

1 Less than 1 month.
2 More than 1 month, less than 6 months.
3 More than 6 months, less than 12 months.
4 More than 12 months, less than 18 months.
5 More than 18 months, less than 24 months.
6 More than 24 months, less than 36 months.
7 More than 36 months.

117. Total months experience in present job is:

1 Less than 1 month.
2 More than 1 month, less than 6 months.
3 More than 6 months, less than 12 months.
4 More than 12 months, less than 18 months.
5 More than 18 months, less than 24 months.
6 More than 24 months, less than 36 months.
7 More than 36 months.

118. Your race is:

1 American Indian or Alaskan Native
2 Asian or Pacific Islander
3 Black, not of Hispanic Origin
4 Hispanic
5 White, not of Hispanic Origin
6 Other

119. Your sex is:

1 Male
2 Female

120. Your weight is:

1 Less than or equal to 100 pounds.
2 More than 100, less than or equal to 125.
3 More than 125, less than or equal to 150.
4 More than 150, less than or equal to 175.
5 More than 175, less than or equal to 200.
6 More than 200, less than or equal to 225.
7 More than 225.

121. Your height is:

1 Less than or equal to 5 feet.
2 More than 5 feet, less than or equal to 5 feet 3 inches.
3 More than 5 feet 3 inches, less than or equal to 5 feet 6 inches.
4 More than 5 feet 6 inches, less than or equal to 5 feet 9 inches.
5 More than 5 feet 9 inches, less than or equal to 6 feet.
6 More than 6 feet, less than or equal to 6 feet 3 inches.
7 More than 6 feet 3 inches.

122. Your age is:

1 Less than 20.
2 20 to 25.
3 26 to 30.
4 31 to 40.
5 41 to 50.
6 More than 50.

123. If you smoke cigarettes, you smoke the following number of cigarettes:

1 I do not smoke cigarettes.
2 Less than 5 per day.
3 6-10 per day.
4 11-20 per day.
5 21-30 per day.
6 31-40 per day.
7 More than 40 per day.

124. If you smoke a pipe or cigars, you smoke the following number of pipe bowls or cigars:

1 I do not smoke a pipe or cigars.
2 Less than 2 bowls or cigars per day.
3 2-4 bowls or cigars per day.
4 5-6 bowls or cigars per day.
5 7-8 bowls or cigars per day.
6 9-10 bowls or cigars per day.
7 More than 10 bowls or cigars per day.

125. You engage in physical exercise:

1 Less than 1 hour per week.
2 More than 1 hour, less than or equal to 2 hours per week.
3 More than 2 hours, less than or equal to 3 hours per week.
4 More than 3 hours, less than or equal to 4 hours per week.
5 More than 4 hours, less than or equal to 5 hours per week.
6 More than 5 hours, less than or equal to 6 hours per week.
7 More than 6 hours per week.

126. Have you recently, within the last year, experienced any of the following: death of your spouse, divorce, marital separation, death of a close family member, or serious personal injury?

1 No.
2 Yes, one of the above.
3 Yes, two of the above.
4 Yes, three of the above.
5 Yes, four of the above.
6 Yes, all of the above.

127. Your lifestyle away from your job is extremely tense and stressful.

1 Not at all.
2 To a very little extent.
3 To a little extent.
4 To a moderate extent.
5 To a fairly large extent.
6 To a great extent.
7 To a very great extent.

128. Your highest educational level obtained was:

1 Non high school graduate
2 High school graduate or GED
3 Some college work
4 Bachelor's degree
5 Some graduate work
6 Master's degree
7 Doctoral degree

129. If you are a jogger, the average number of miles you jog per week is:

1 I do not jog.
2 1-2 miles.
3 3-4 miles.
4 5-6 miles.
5 7-8 miles.
6 9-10 miles.
7 More than 10 miles.

130. Highest level of professional military education (residence or correspondence):

1 None or not applicable.
2 NCO Orientation Course or USAF Supervisor Course (NCO Phase 1 or 2).
3 NCO Leadership School (NCO Phase 3).
4 NCO Academy (Phase 4).
5 Senior NCO Academy (Phase 5).
6 Squadron Officer School.
7 Intermediate Service School (Officer)
8 Senior Service School (Officer) (e.g., Air War College).

131. How many people do you directly supervise (i.e., those for which you write performance reports)?

1 None
2 1 to 2
3 3 to 5
4 6 to 8
5 9 to 12
6 13 to 20
7 21 or more

132. Does your supervisor actually write your performance report?

1 Yes
2 No

133. Your work requires you to work primarily:

1 Alone.
2 With one or two people.
3 As a small group team member (3 to 5 people).
4 As a large group team member (6 or more people).
5 Other.

134. How stable are your work hours?

1 Highly Stable--Routine 8 hours a day.
2 Very Stable--Nearly routine 8 hour day.
3 Moderately Stable--Shift work which periodically changes.
4 Slightly Unstable--Irregular working hours.
5 Highly Unstable--Frequent TDYs, frequently on call.

135. Your job requires how much communicatio. etween workers?

1 Very little
2 Little
3 Moderate
4 Very Frequent
5 Almost continuous

136. To what extent in your work group are group meetings used to solve problems and establish goals and objectives?

1 None
2 Occasionally
3 About half the time
4 Almost totally

137. Your work schedule is basically:

1 Shift work, usually days.
2 Shift work, usually swing shift.
3 Shift work, usually nights.
4 Shift work, usually days and nights.
5 Daily work only.
6 Crew schedule.
7 Other.

138. Which of the following best describes your career or employment intentions?

1 Planning to retire in the next 12 months.
2 Will continue in/with the Air Force as a career.
3 Will most likely continue in/with the Air Force as a career.
4 May continue in/with the Air Force.
5 Will most likely not make the Air Force a career.
6 Will separate/terminate from the Air Force as soon as possible.

139. Are you currently (within the last week) taking <u>any</u> prescribed or non-prescribed medication?

1. No.
2. Yes. If yes, then turn to the next page and fill in your <u>identification number</u> (the one on the lower right corner of your optical scan form) and complete the page.

PLACE I.D. NUMBER HERE

1. Medication Name:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

2. Use (if known):

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

3. Dosage (if known):

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

APPENDIX B

REGRESSION EQUATIONS

The following symbols designate each independent and dependent variable in the following regression equations. Additionally, the methodology employed in this study kept all main effects and control variables in the regression equation whether they were significant or not. In the following equations, the significant terms will be indicated by an asterisk (*).

Independent Variables

X_1 = Role Conflict

X_2 = Organizational Climate

X_3 = Locus of Control

X_4 = Type A/B Behavior Pattern

X_5 = Role Conflict x Type A/B Behavior Pattern

X_6 = Sex

X_7 = Age

X_8 = Jogging

Dependent Variables

Y_1 = Perceived Job Stress

Y_2 = Cortisol Level

Y_3 = Total Cholesterol

Y_4 = HDL Cholesterol Level

Y_5 = Total Cholesterol/HDL Cholesterol Ratio

Total Sample

$$Y_1 = 0.320X_1^* - 0.433X_2 + 0.188X_3 - 1.13X_4^* - 0.280X_6 + 0.566X_7 - 0.512X_8 + 5.863$$

$$Y_2 = 2.43X_1 + 0.323X_2 - 0.127X_3 + 2.850X_4 - 0.983X_5^* + 2.425X_6^* - 0.286X_7 - 0.376X_8 + 4.878$$

$$Y_3 = -2.474X_1 + 1.058X_2 + 2.430X_3 - 2.702X_4 + 7.845X_6 + 10.596X_7^* - 1.412X_8 + 163.659$$

$$Y_4 = 0.051X_1 + 0.574X_2 + 0.826X_3 + 1.037X_4 - 12.687X_6^* + 0.149X_7 + 1.084X_8^* + 47.087$$

$$Y_5 = -0.083X_1 - 0.018X_2 - 0.021X_3 - 0.231X_4 + 1.330X_6^* + 0.301X_7^* - 0.161X_8^* + 3.711$$

Male Sample

$$Y_1 = 0.284X_1^* - 0.116X_2 + 0.169X_3 - 1.037X_4^* + 0.268X_7^* - 0.075X_8 + 4.930$$

$$Y_2 = -0.317X_1 + 0.175X_2 - 0.188X_3 - 0.300X_4 + 0.151X_7 - 0.442X_8 + 15.237$$

$$Y_3 = -2.806X_1 - 1.048X_2 + 1.010X_3 - 4.815X_4 + 9.812X_7^* - 1.551X_8 + 195.580$$

$$Y_4 = -0.123X_1 + 0.700X_2 + 0.868X_3 + 2.484X_4 - 0.820X_7 + 1.015X_8^* + 34.942$$

$$Y_5 = -0.076X_1 - 0.080X_2 - 0.064X_3 - 0.383X_4 + 0.380X_7^* - 0.161X_8^* + 5.465$$

Female Sample

$$Y_1 = 0.392X_1^* + 0.094X_2 + 0.281X_3 - 1.623X_4^* - 0.271X_7 + 0.508X_8^* + 6.744$$

$$Y_2 = 6.979X_1^* + 0.796X_2 + 0.239X_3 + 6.282X_4 - 2.645X_5^* - .0552X_7 + 1.827X_8 - 10.113$$

$$Y_3 = -1.789X_1 + 5.931X_2^* + 5.615X_3 + 1.898X_4 + 14.681X_7^* + 1.893X_8 + 95.989$$

$$Y_4 = -0.294X_1 + 0.608X_2 + 1.359X_3 - 3.305X_4 + 2.486X_7 + 1.928X_8 + 44.518$$

$$Y_5 = -0.091X_1 + 0.096X_2 + 0.046X_3 + 0.160X_4 + 0.174X_7 - 0.100X_8 + 2.481$$

Males Under 40 Years Old

$$Y_1 = 0.425X_1^* + 0.019X_2 + 0.125X_3 - 0.748X_4^* + 0.322X_7 - 0.065X_8 + 2.932$$

$$Y_2 = -0.312X_1 + 0.020X_2 + 0.409X_3 - 1.100X_4 - 0.382X_7 - 0.070X_8 + 16.900$$

$$Y_3 = 1.656X_1 + 1.119X_2 + 3.627X_3 - 1.374X_4 + 11.132X_7^* + 0.123X_8 + 143.917$$

$$Y_4 = -1.328X_1 - 0.059X_2 + 1.502X_3 + 3.780X_4 - 1.308X_7 - 0.028X_8 + 41.914$$

$$Y_5 = 0.182X_1 + 0.045X_2 - 0.074X_3 - 0.379X_4 + 0.360X_7^* - 0.003X_8 + 3.603$$

Males Over 40 Years Old

$$Y_1 = 0.211X_1^* - 0.210X_2^* + 0.144X_3 - 1.167X_4^* - 0.077X_7 - 0.065X_8 + 7.855$$

$$Y_2 = -0.378X_1 + 0.375X_2 - 0.547X_3 + 0.156X_4 - 0.245X_7 - 0.871X_8^* + 17.502$$

$$Y_3 = -6.021X_1^* - 1.826X_2 - 2.492X_3 - 7.631X_4 + 10.728X_7 - 3.631X_8 + 226.830$$

$$Y_4 = 0.465X_1 + 0.809X_2 + 0.606X_3 + 1.743X_4 - 0.436X_7 + 2.416X_8^* + 30.615$$

$$Y_5 = -0.226X_1 - 0.095X_2 - 0.106X_3 - 0.405X_4 + 0.285X_7 - 0.358X_8^* + 7.138$$

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